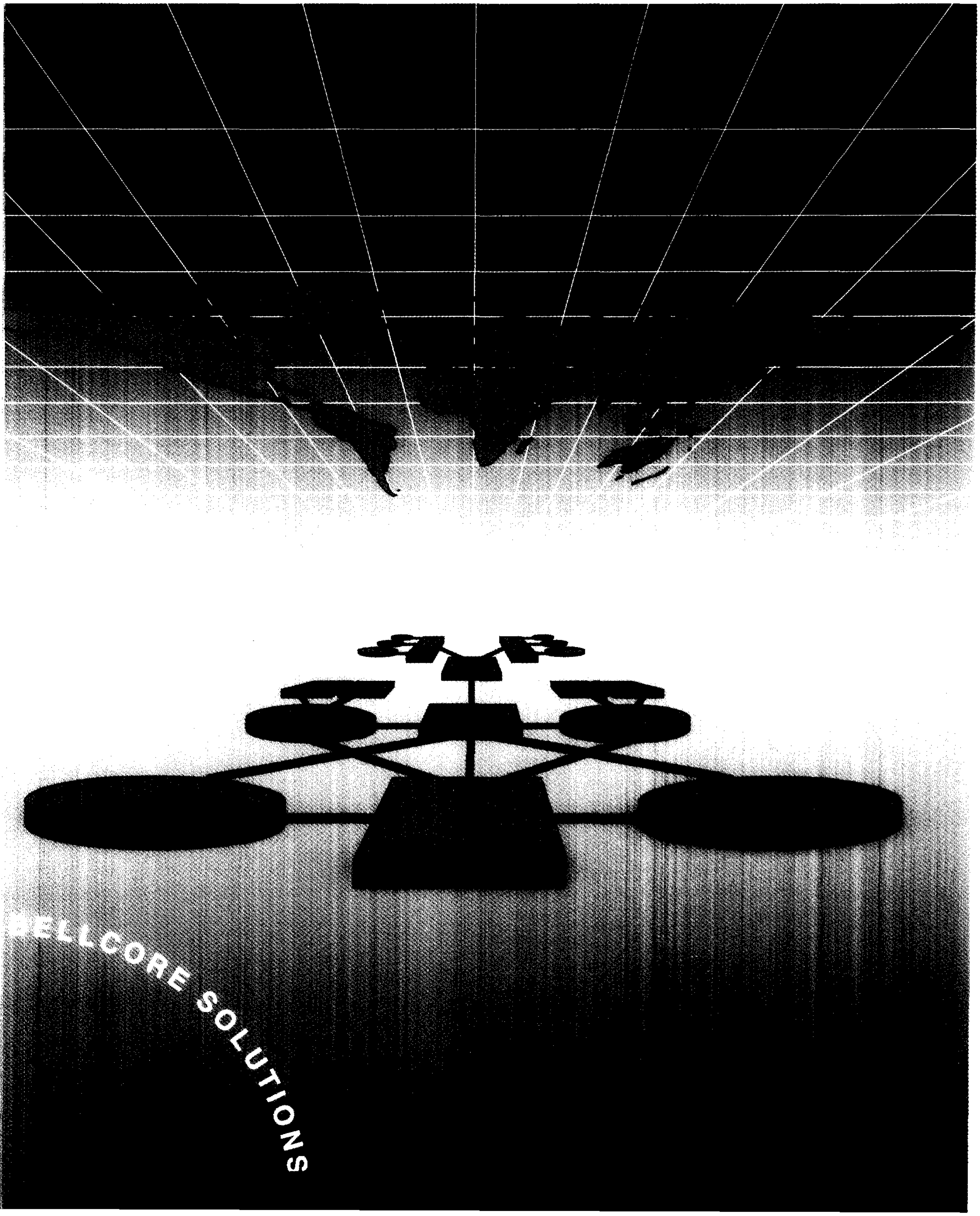
Bellcore

Bell Communications Research

Telecommunications Network



The telecommunications field is exploding with rapidly changing architectures, complex technologies, and new opportunities as a result of increasing competition. Service providers require precise knowledge of the cost of products offered on the network. Bellcore and its family of network costing software will enhance your ability to quickly and accurately determine the costs of new and existing services and will help to ensure your company's success in this dynamic environment.

Bellcore's Telecommunications Network Cost models provide:

- Easy-to-use leading edge software that runs on IBM compatible personal computers.
- Costing intelligence for enhancing business decision making.
- Independently verifiable results.
- Cost methodology widely accepted by regulatory entities.
- Full user support provided by a staff of experts with extensive telecommunications experience.
- Dynamic development with regular software updates to reflect the most current technologies.
- A large library of user guides that document each Bellcore cost model.
- Hands-on training by subject matter experts.
- Instructor-led courses on cost model methodology.

The **Bellcore's Telecommunications Network Cost** software models provide a comprehensive family of tools that permit you to determine the "cost of services" provisioned on your telecommunications network.

Bellcore's Cost Method and Applications group have unique and extensive experience in costing and regulatory issues. This valuable resource can also be provided in consultative engagements.

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COSTING OF TELECOMMUNICATIONS NETWORK SERVICES

The Need for Telecommunications Service Cost Studies

The provision of telecommunications services has become increasingly complex. This complexity arises from new technologies that permit the introduction of sophisticated new services, while at the same time the environment is shifting towards, privatization, liberalization, and competition.

The telecommunications industry is extremely capital intensive. As a direct result of growing competition and advancing technology, it is imperative to assure effective recovery of network investments. Understanding the cost causation's relationships are critical to ensure that appropriate business decisions are made and that tariffs are designed to help optimize network cost recovery.

In addition, rigorous service cost studies will satisfy the regulator needs for a basis to determine if the rates charged by the service providers are reasonable and effective in meeting regulatory and social objectives, such as promoting universal service, interconnection, and identifying specific cost causation of competitive and non-competitive services. The service cost analysis should be based on detailed modeling of the switching and transmission network, and meet the needs of both the telephone companies and the regulators.

Benefits of Bellcore's Telecommunications Network Cost Models

Proper business decisions in the telecommunications industry have always been critical, and are becoming even more so, given the increased competition and the rapid technology changes taking place. The Bellcore telecommunications network cost models can help you and your company make good business decisions in three major areas:

- Performance Measurement Analyses
- Tariffing
- Regulatory Requirements

Performance Measurement Analyses - Accounting and financial reporting, although critical, is only part of your financial picture. The Bellcore models provide the information necessary to complete your company's view of its cost and profitability structure by identifying the accurate incremental cost of each service and product. This information will provide the underpinnings for many internal business decisions, some of which are listed below.

> ***Profitability/contribution analyses*** by service, market segment, or geographical serving area can be determined by using the Bellcore cost models for the cost side of the analyses. Understanding your costs by these various segmentations gives added information you can use as you make business decisions about product entry/exit, identifying where pricing levels may need to be adjusted to maximize contribution, determining the appropriate pricing structure, or substantiating the need for multiple prices for geographical-based pricing. These examples are just a small sample of the types of decisions that a good profitability analysis can support.
>
> ***Long-range planning*** allows you to perform "what-if" analyses that can help you determine the cost of new services or old services on new technology platforms; e.g., digital switches, fiber optic trunking facilities, AIN, etc.
>
> ***Quantification of cross subsidizations*** among competitive/non-competitive services will ensure that your prices will be self-supporting.

Tariff rebalancing of local loop, local calling, long-distance calling, and international calling cannot be accomplished without understanding the cost of each of these services, and the Bellcore models can provide this critical data.

Transfer pricing can be established for telecommunications services "sold" to other business units.

Competitive analyses can be performed using the Bellcore cost models. They can estimate the service cost levels at which competitors could enter the market, based on user-entered assumptions about the competitor's network, such as an all fiber network or the deployment of a particular type of network hierarchy.

New service introduction analysis requires a complete understanding of the service's costs, and the Bellcore models can provide this important aspect of the analysis.

Tariffing - The Bellcore models can assist you in identifying the appropriate cost "floor" for hundreds of services, some of the most important are listed below:

- Basic Voice Services
- Residential Premium Services
- Business Features (PBX Connection and Centrex)
- Interconnection Rates for:
    - Mobile Carriers
    - Long-Distance Carriers
    - International Carriers
    - Cellular Personal Communication Networks
    - Cellular Paging Services
    - Geographically Adjacent Carriers

Regulatory Requirements - Regulatory requirements vary tremendously from one area to another, but some of the most important issues that the Bellcore models can assist you with are listed below:

Open Network Architecture/Provisioning requires appropriate tariff structures and defensible rates.

Universal Service Obligation quantification can be identified with the Bellcore cost models.

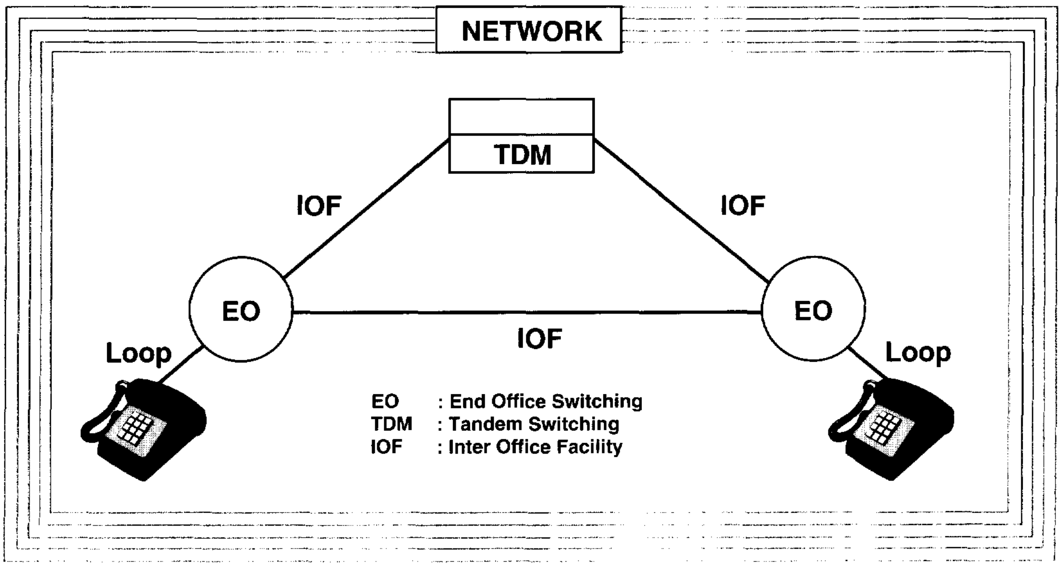
Cross Subsidization Issues can be addressed using the incremental costs that the Bellcore models provide.

Predatory Pricing Issues can be minimized if the incremental costs provided by the Bellcore models are used as a cost floor.

In summary, the benefits of the Bellcore cost models can assist you in the strategically important issues of tariff rebalancing, interconnection charges, competitive assessments, and performance measurements.

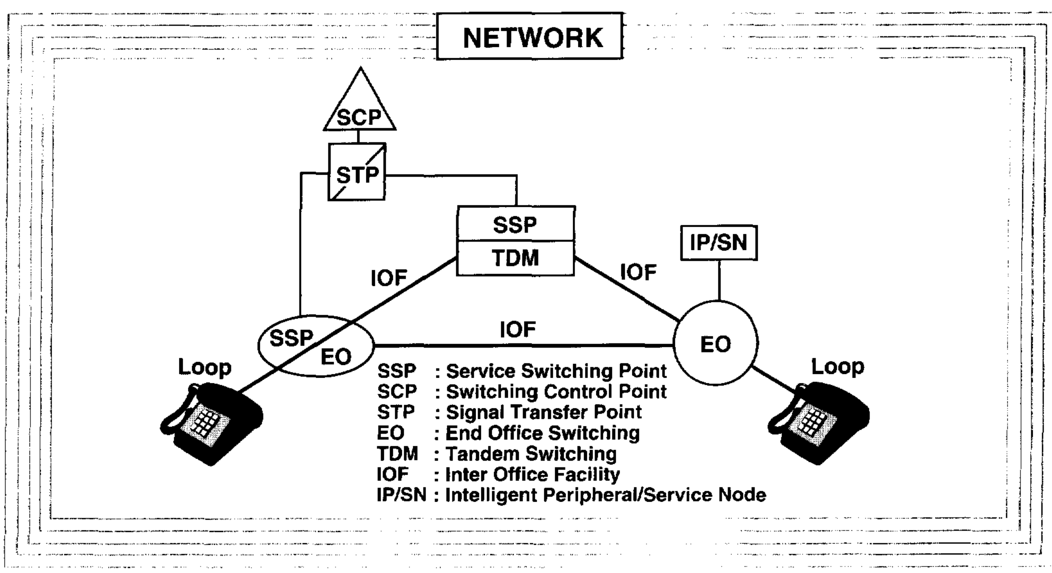
Cost Causation in the Network

The public switched telephone network (PSTN) is a system of switching and transmission equipment that provides end-to-end communications. The following figure depicts the traditional voice network architecture of the PSTN.



Typically, the PSTN encompasses the subscriber loops and a hierarchy of switches connected to each other by facilities or trunks arranged in layers which perform local, tandem or transit switching functions and operator services. The network is usually composed of a mix of various technologies; digital, analog, fiber, and copper, which may be provided by a multitude of vendors. Given the wide spectrum of technologies deployed and the great variety of services offered, the cost of a specific service can only be studied through a detailed analysis of the network components utilized by the service.

With the availability of Signaling System 7 (SS7) and the intelligent network architecture, additional network elements, such as Service Switching Points (SSPs), Switching Control Points (SCPs) and Signal Transfer Points (STPs) are overlaid onto the PSTN network, as illustrated in the following figure.

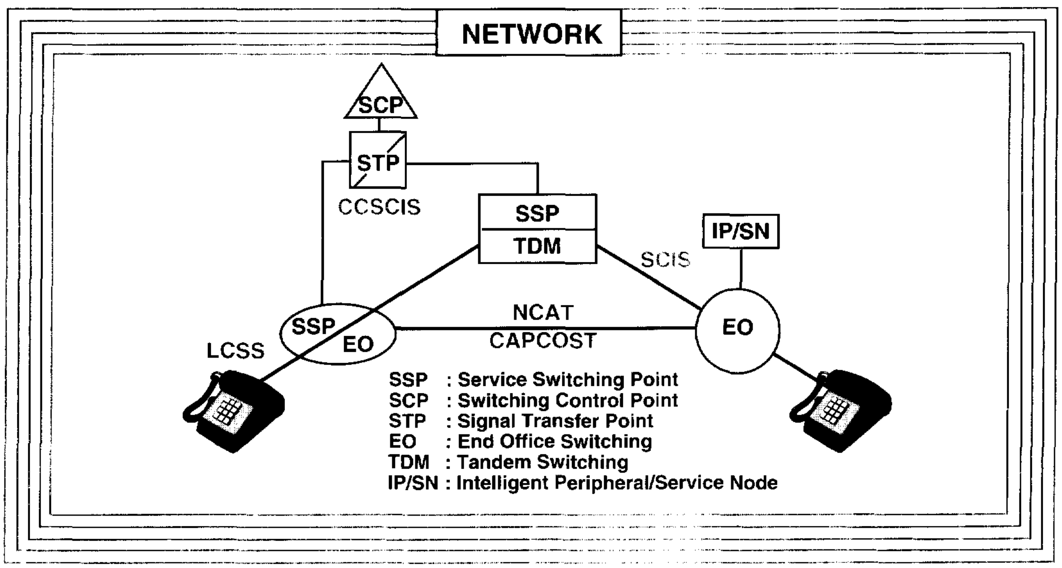


This digital overlay is accompanied by significant network capabilities and new service possibilities.

Bellcore's Cost Models

Bellcore has developed a suite of cost models to assist the analyst in determining the marginal and average cost for the provision of locally defined basic and value-added services, using both vendor information and actual network data.

The following figure shows the application of these models to the costing of the various network functionalities.



Digitalization enables the provisioning of many different services on network components that are increasingly shared among the many services. The "shared" network provides economies of scale in traffic levels per route, and economies of density in subscriber lines, etc., but at the same time, the sharing phenomenon makes it difficult for a cost analyst to determine the cost of a specific service or call on the network.

Although the network is "shared" it is also "engineered" according to individual component capacities to serve the expected demand; i.e., most of the network investment that appears shared is actually volume sensitive. The Bellcore cost models use a detailed, "bottom up" engineering modeling process incorporating sound economic principles to capture the long run, forward- looking incremental investments caused by a specific call or service on the network.

To determine the usage cost of the traditional network, an analyst would use the **Network Cost Analysis Tool (NCAT).** This model calculates the cost of network services based on existing or forecasted traffic loads. NCAT provides the analyst with the cost of setting up a call, and the per minute and per message (minute of use or meter) cost of a call over varying distances and times of day. An analyst could use this model to evaluate point-to-point costs associated with different network configurations.

The **Switching Cost Information System (SCIS)** provides detailed cost analysis of switches manufactured by various vendors. An analyst would use this model to determine the marginal or current average switching investments for basic telephone service, premium features, and advanced services for the different switching technologies.

With the introduction of the intelligent network architecture based on the SS7 signaling capabilities, the **Common Channel Signaling Cost Information System (CCSCIS)** enables the analyst to determine the cost of the SS7 network, including the STPs, SCPs, and signaling links associated with the provisioning of intelligent network services.

To determine the investments and cost for customer loops from their premises to the local exchange office, an analyst would use the **Loop Cost Support Services (LCSS)**.

The **Capital Cost Analysis System (CAPCOST PLUS)** translates network investments into annual capital costs. CAPCOST PLUS takes into consideration the different depreciation lives of the equipment, tax laws, and the cost of money concept in developing the appropriate annual capital costs.

All of Bellcore's cost models are PC-based and are customized to appropriately reflect a local telecommunication provider's environment. Together, the Bellcore cost models provide a comprehensive family of software tools that can be used to determine the costs of services using generally accepted microeconomic theories. These systems are widely used for many business support decisions and for support in the regulatory arena.

Hardware and Software Requirements

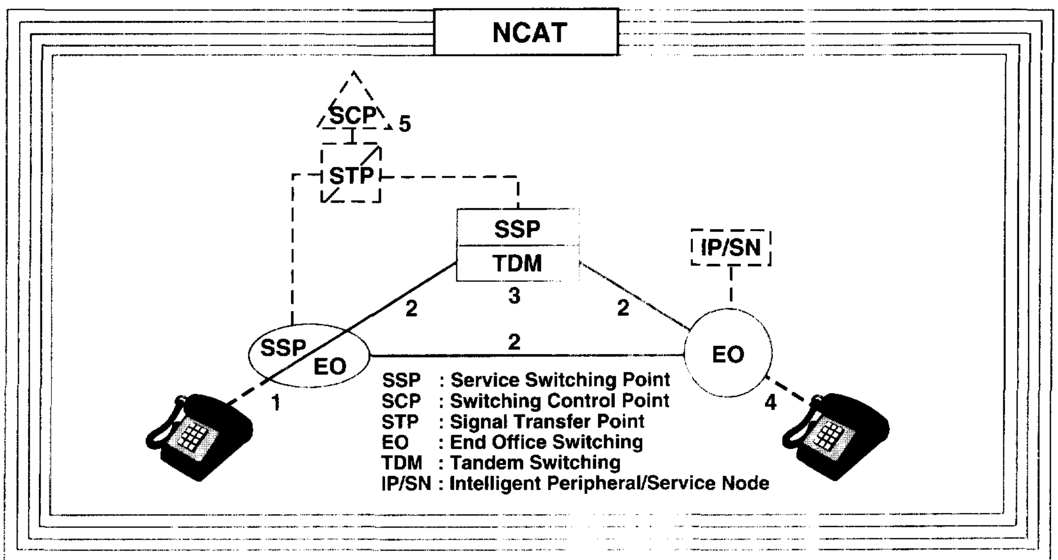
The following is a list of the minimum hardware and software requirements needed to run any or all of the Bellcore Network Cost Analysis models:

- An IBM-compatible personal computer based on an 80486 or Pentium microprocessor
- 8 megabytes or more of extended RAM
- 100 megabytes of free hard disk space
- A laser or dot-matrix printer
- A mouse
- MS-DOS or PC-DOS Version 5.0 or greater
- Microsoft Windows™ 3.1 or Windows 95
- Super VGA (SVGA) Color monitor

Network Cost Analysis Tool (NCAT)

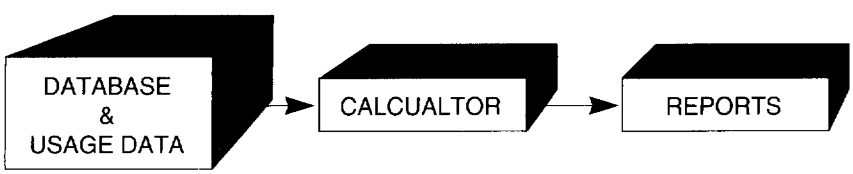
General Description

The Network Cost Analysis Tool (NCAT) is a large-scale system that calculates the incremental cost of traffic on the public switched network.



NCAT calculates the cost of traffic, starting with the originating switch (1), over the network through the available trunk groups (2), the tandem switches, up to five levels (3), and ends at the terminating point (4), as shown in the above figure. NCAT has the capability to include Common Channel Signaling costs (5), which are derived from CCSCIS. Costs are calculated for all existing network routes, by distance band and time of day, and a composite cost is developed based on the overflow characteristics of the network.

The NCAT Model consists of four major components: the database, usage data, the calculator, and the report generator as shown below.



NCAT Input Requirements

DATABASE - It contains the necessary information required by the calculator to perform service-specific network cost analysis.

The database consists of three components: the ***Network Component***, the ***Investment Component***, and the ***Study Parameters Component***.

The ***Network Component*** contains information describing the physical characteristics of the network, along with homing and routing arrangements. This component contains an inventory of the switches and trunk groups used to carry traffic in the designated studied area.

Switch, ***facility***, and ***routing*** data required for the Network Component are:

Switch Information - Identifies each switch, the function it performs, the location, and the busy hours. Examples of required data would be:

(a) Switch Identified
(b) Office Function
(c) Location
(d) Technology
(e) Function
(f) Busy Hour(s)

Facility Information - Identifies each trunk group in the network, the number of circuits and route lengths, and if available, the busy hour and overflow characteristics. Examples of required data would be:

(a) Direction of traffic
(b) Number of Circuits
(c) Length of Circuits
(d) Busy Hour
(e) Overflow Characteristics
(f) Engineering Parameters

Routing Information - Hierarchical routing rules are used by the system. These rules differ by service and may be overridden by the user.

The ***Investment Component*** contains switching investments data by traffic category, and facility/termination investments data on a per circuit mile or kilometer, and per termination basis.

The Investment data includes:

- Switch unit investments (technology-specific and/or office-specific). This information can be obtained via a mechanized interface from SCIS.

- Facility and termination unit investment.

- Annual cost factors, inflation factors, and other telephone company factors.

The ***Study Parameters Component*** defines the service that is being studied, non-conversation time per call, completion ratios and growth factors, and tariff characteristics. This component also provides user control of the algorithms used by the calculator.

USAGE DATA - Service-specific costs are generated by the calculator, based on point-to-point traffic loads for the service under study. The system is designed to run with hourly usage for each pair of network endpoints based on an average business day during the busy season. This data can be derived from customer billing records. Some services may not have such data readily available. In that case, traffic flow models are provided in NCAT to develop the point-to-point usage records based on aggregate data derived from Subscriber Line Usage Studies (SLUS) or similar studies.

NCAT System Processing

CALCULATOR - This is the component that computes the network costs and allocates them by distance band and time-of-day rate period. The calculator processes each usage record for the designated service and applies a stimulation factor for each record to develop an incremental traffic load. The traffic is then routed over the network in conformance with the rules and network relationships defined in the network component of the database. Costs can be derived for first choice route and alternate routing based on the network hierarchy and overflow characteristics of the trunk groups involved in completing the traffic.

NCAT Output Reports

STANDARD CALCULATOR REPORT - It formats and summarizes the cost and investment information generated by the calculator into a set of output reports. The system generates six standard reports:

1. **Annualized Incremental Messages and Minutes by Distance Band and Rate Period** - This report displays the total incremental traffic generated through network usage stimulation.

2. **Traffic Sensitive Unit Cost (Setup Related)** - This report displays the unitized annual costs related to call setup and disconnect. Results are displayed as total, switching related, which is broken down into end office switching, tandem switching, and measurement equipment, and trunking related, which is broken down by facility and termination, and SS7 costs. Results are unitized over incremental annual calls by rate period and distance bands.

3. **Traffic Sensitive Unit Cost (Duration Related)** - This report displays the unitized annual cost associated with call holding time, not including non-conversation time. Results are displayed as total, switching related, which is broken down into end office switching, tandem switching, and measurement equipment, and trunking related, which is broken down by facility and termination, and SS7 costs. Results are unitized over incremental annual minutes of use by rate period and distance band.

4. **Unit Cost Summary** - This report summarizes the results from Reports 2 and 3.

5. **Incremental Investments (Setup)** - This report displays the investment associated with the incremental messages displayed in Report 2. Results are displayed by category: switching, which is broken down into end office switching, tandem switching, and measurement equipment, trunking facility and termination, and SS7 investment.

6. **Incremental Investments (Duration)** - This report displays the investment associated with the incremental minutes of use displayed in Report 3. Results are displayed by switching, which is broken down into end office switching, tandem switching, and measurement equipment, trunking facility and termination, and SS7 investment categories.

NCAT Applications

The Network Cost Analysis Tool is designed primarily to provide cost support for tariffed services on the public switched network. There are two basic types of services that NCAT studies.

The first type of service involves the cost of transport through the network on an end-to-end basis, by the company performing the analysis. In this case, the company would normally provide the bulk of the switching and trunking between the originating and terminating points. Examples include local exchange and toll message services that are usage-sensitive. NCAT provides the cost basis for developing end user charges. NCAT can also be used to evaluate alternate network deployments, based on network traffic, by varying user inputs.

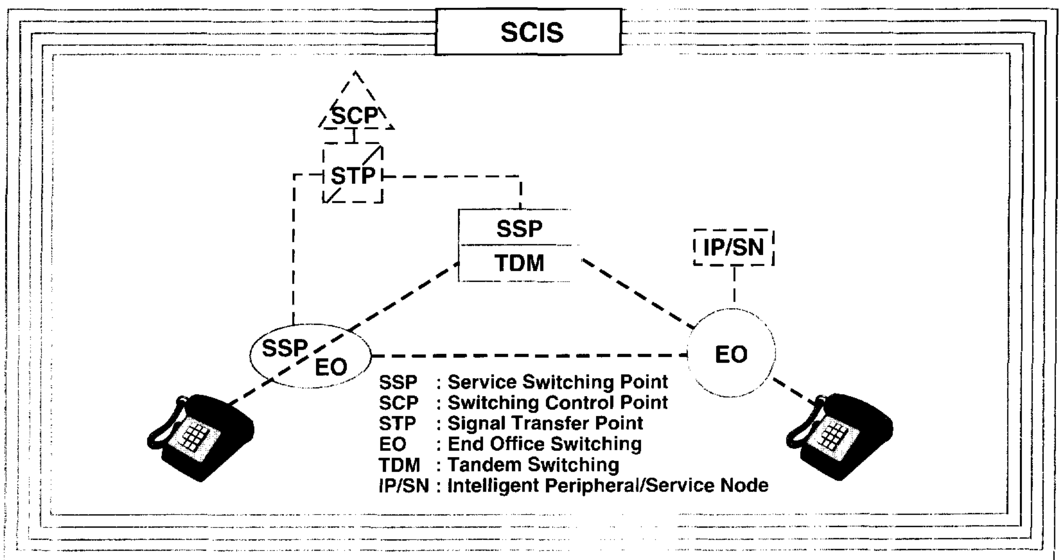
The second type of service involves interconnection between networks, where one carrier delivers traffic to another carrier at a point of interconnection. Carrier Access service to an overseas carrier or to a competitive carrier in the same service area are examples of this type of service. NCAT determines the cost for the network interconnection which could be the basis for developing interconnection charges.

NCAT's underlying methodology is designed to study the cost of transporting traffic over the network as it is currently configured, or as projected for the study period. However, this is not a strict requirement of the system. NCAT can also be used to determine the cost of transporting traffic over alternative network configurations. Therefore, it is also possible to use NCAT for evaluating the financial impact of alternate network deployment, bypass potential, and the simulation of the cost of competitive networks.

Switching Cost Information System (SCIS)

General Description

The Switching Cost Information System is a PC-based family of software models that determines switching used to provide investment services. The figure below functionally illustrates the network's end offices and tandem offices that are part of the SCIS analysis.



The SCIS model is comprised of two functionally separate modules for each switch technology:

MODEL OFFICE MODULE -
SCIS/MO (Switching Cost Information System/Model Office) analyzes the switching system and develops the costs of basic switching functions for each individual switch technology.

FEATURE COSTING MODULE -
SCIS/IN (Switching Cost Information System/Intelligent Network) calculates investments for features or value-added services provided by each switching system.

SCIS analyzes user-defined switching systems and their subscriber usage for service applications. SCIS provides users with basic switching resources investments and feature or service-specific investments. Model options permit users to select marginal or average investment analysis methodologies to accommodate their study perspective, which allows the user to perform cost studies according to local or regulatory requirements.

SCIS studies may involve either single or multiple switch environments, including any remote switching systems and their hosts. Multiple switch cost study outputs are proportionately weighted to reflect all host and remote switch resource investments.

The SCIS/MO module outputs quantify investments for basic switching functionalities, such as the investment per central processor millisecond, the investment per line termination, the investment per originating or terminating call functions, and the investment per line or trunk usage. These functional resources are subsequently aggregated in SCIS/IN algorithms to determine the switching investments used by specific feature or value-added services.

SCIS currently models end office, combined end office/tandem, tandem, and remote switches for the following technologies:

- AXE-10 (Ericsson Network Systems)
- DCO (Siemens/Stromberg-Carlson)
- DMS-10 (Nortel)
- DMS-100 Family (Nortel)
- EWSD (Siemens/Stromberg-Carlson)
- Fetex-150 (Fujitsu)
- NEAX-61E (NEC)
- System 12 (Alcatel)
- 1A ESS (AT&T)
- 4ESS (AT&T)
- 5ESS (AT&T)

Additional technologies under consideration are Alcatel E10 and Nokia, and others can be modeled at customer request.

SCIS/MO provides the investments associated with basic switching functions for end offices and tandem offices needed by other network services cost models. Investments for basic switching functionalities may also be exported via electronic data files to other models, such as the Network Cost Analysis Tool (NCAT) for development of network switching investments. NCAT uses SCIS-generated functional resource costs to calculate the switching component of network message traffic costs, interconnection costs, operator assisted calls, and many other types of network services.

SCIS User Input Requirements

SCIS/MO requires two groups of inputs. The first group includes cost study parameters, such as the type of investments to be calculated (marginal or average), applicable vendor discounts, and other financial parameters. The second group details service characteristics for each standalone/host and remote switch included in the study, such as analog and digital line and trunk quantities, line and trunk usage and call rates, and processor utilization data.

SCIS/IN requires two groups of inputs. The first group includes cost study parameters and the second type includes usage data for the specific features being studied.

Switching System Manufacturer Inputs

Bellcore obtains detailed technical information, under special agreements, directly from the switching system manufacturers. This data consists of engineering rules, price lists, system and individual component capacities, and processor resource consumption for individual features and services. This information transfer and ongoing working relationships with the switch vendors helps ensure that SCIS reflects the highly complex switching architecture of each switching system on a current basis.

SCIS System Processing

SCIS processing represents the application of widely accepted economic theory to the engineering of switching components, in order to accurately identify cost causation relationships. It is forward-looking and uses replacement value principles to identify the switch investments required to provide services. The SCIS models mathematically replicate the inner workings of a switch, based on the engineering architecture specific to each switch manufacturer. SCIS results are validated against each manufacturer's own engineering tools to insure integrity of study conclusions.

SCIS/IN uses the SS7 network resource investments from the Common Channel Signaling Cost Information System (CCSCIS) model, along with the SCIS/MO results in its algorithms to identify the investments for Intelligent Network Services such as CLASS, and Advanced Intelligent Network (AIN) services.

SCIS Output Reports

SCIS produces two types of reports - the Model Office Report, which accounts for the cost of basic switching functionalities, and the Feature Report, which accounts for the switching cost for premium features and advanced services.

SCIS/MO Report - This report is generated for each switch model and displays switching function results. The results are calculated by SCIS using switch-specific assumptions, engineering rules, user input discounts, and a vendor list of prices for the switching system components. SCIS also produces the total switch-specific cost (excluding special feature hardware) and categorizes the costs into basic switching functions, such as line termination investment, usage investment, and call investment.

The model generates three major types of reports. Additional output reports can also be selected by the user if additional detail is desired. The reports generated are:

1. **Grand Weighted Unit Investment** - This report displays the average of all host and associated remote switches weighted by the relative size or traffic of the individual switches of the same technology in the study.
2. **Weighted Unit Investment** - This report displays the weighted investment associated with subsets of host and remote switches (e.g., host type, remote type) included in the study.
3. **Node Unit Investment** - This report displays the investments associated with each host and remote office in a study and includes total investments for that node.

SCIS/IN Feature Report - The outputs from the model office report are used to calculate feature and value-added service investment information. These SCIS/IN feature reports are produced for each of the services and features available in the SCIS family of switch models. SCIS/IN will produce a specific service or feature output report for each switch type under study. The report categorizes the types of investment for the service by basic switching function, such as call setup, usage, memory, and feature-specific hardware. SCIS/IN may contain hundreds of services and features, depending upon the vendor.

The system further identifies the costs by type of economic cost; i.e., fixed direct, fixed shared, and variable. SCIS/IN produces weighted average results when multiple switch technologies are included in a study.

SCIS Applications

A critical need for successful management in today's increasingly competitive environment is to understand product costs. The SCIS cost models can help telephone companies determine their product costs which may be used to:

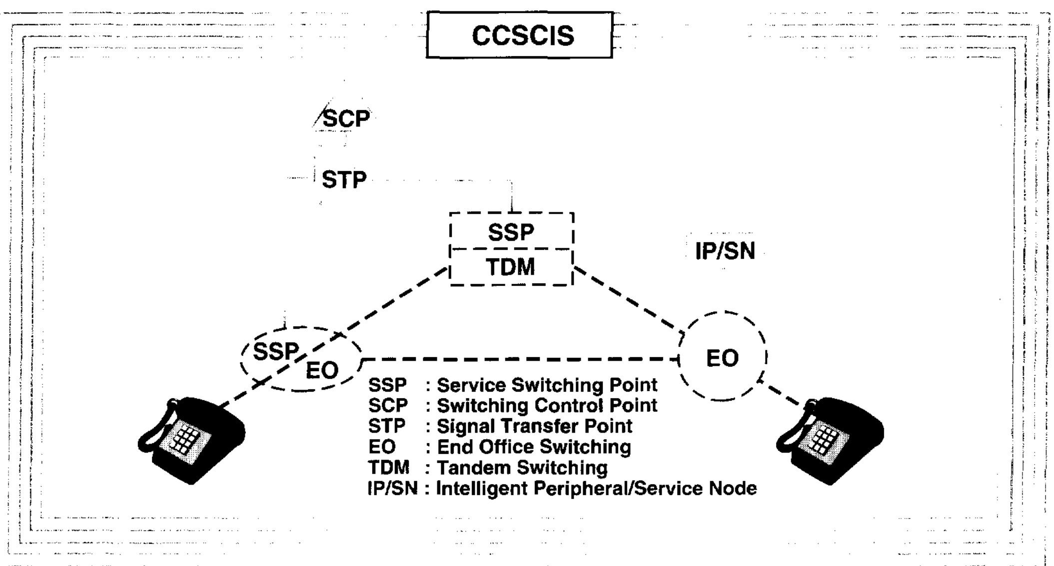
- Provide service cost data for cross subsidization analyses.
- Establish price floors for the pricing of competitive services.
- Establish cost floors for transfer prices.
- Identify the costs and appropriate levels of Open Network Provisioning.
- Develop business case studies for new services and technologies, such as ISDN and AIN.
- Provide service cost data for profitability studies and contribution analysis.
- Determine appropriate rate structures for features and services.

Common Channel Signaling Cost Information System (CCSCIS)

General Description

The Common Channel Signaling Cost Information System (CCSCIS) is a collection of models which calculate the costs of a Signaling System 7 (SS7) network as shown in the following figure.

CCSCIS can be used to study the costs of Service Control Points (SCPs), Signal Transfer Points (STPs), and various types of SS7 signaling links. SCPs are data bases of information used by switches for processing calls. STPs are packet switches which route the signaling messages between points in the network that originate and/or terminate messages. The SS7 signaling links connect SCPs, STPs, and switches with SS7 capability.



CCSCIS aggregates the costs of the SS7 network components to produce the costs of sending signaling messages between switches and/or between switches and SCPs, STPs, or signaling interface points. These costs can be used in NCAT to determine the cost of SS7 signaling for setting up calls. They can also be used in SCIS/IN to determine the cost of using SS7 to provide intelligent network services. The models in CCSCIS include:

(1) A Link Model to calculate the costs of the various signaling links.
(2) Five STP models (AT&T 2A STP, AT&T A-I-Net STP, DSC DEX STP, Ericsson AXE STP, and NTI DMS STP).
(3) Six SCP models (three Bellcore/DEC SCPs, an AT&T SCP, a Bellcore/IBM SCP, and an Ericsson SCP).
(4) An Aggregation Model that combines the results of other models. As different types of equipment are added to the network, new models are developed.

CCSCIS Input Requirements

Each model requires data to define the study parameters: the type of costs to be calculated (marginal or average), the length of the study period, the initial year of the study, the forward-looking cost of money. Other inputs can be classified as related to costs, the configuration of the equipment, or the demands for services using the equipment.

LINK MODEL -
The Link Model calculates separate costs for A and E links (between switches and STPs), B and D links (between STPs), and SCP links (between STPs and SCPs). Data describing each type of link are required. Since each link type may include several different facility types (fiber, cable, digital radio), data for each facility type is required for each link type.

The Link Model requires the following inputs for each link type:

Cost Data -
- Facility/termination unit investments
- Annual lease expenses
- Annual cost factors

Equipment Configuration Data -
- Length and terminations of each facility type
- Numbers of links of each facility type
- Engineered maximum occupancy

Demand Data -
- Demands for services using links in several years throughout the study period

STP AND SCP MODELS -
Input requirements for the STP and SCP Models include the following:

Cost Data -
- Discount from equipment vendor's list prices
- Capitalized Right-to-Use Fees or other investments to be included

Equipment Configuration Data -
- Number of links terminated, in different years of the study
- Engineered maximum occupancy of links terminated
- Optional equipment

Demand Data -
- Demands for services, in several years of the study

AGGREGATION MODEL -
Almost all of the data used in the Aggregation Model is output by the other models and can be automatically read in. Additional data requirements include the following:

Cost Data -
Annual charge factors

Equipment Configuration Data -
Whether SCP nodes are duplicated

CCSCIS System Processing

CCSCIS calculates the unit costs and unit investments, as well as total equipment investments, of all non-switch SS7 equipment used in processing calls. The costs are derived from the investments using account-specific cost factors which account for related expenses. Flexibility is provided to permit the analysis to include part of an area served by an SS7 network or the entire network.

For each type of SS7 equipment, the CCSCIS models calculate the costs of categories of equipment with different functions and/or limiting capacities. For each category, capacity costs are determined. These are output as the marginal costs, which may be set to zero if the capacity is not expected to exhaust. These costs are useful for business decisions related to the provision and costing of new services.

The CCSCIS models also calculate average costs which are consistent with full recovery of all current investments. The average costs are developed using two different methods which account for partial and varying utilization of the equipment, changing capacities, and lumpy investments. If all investments are in the initial year of the study period, average costs are calculated as the capacity cost divided by a utilization factor. This cost is consistent with full recovery of the investment if the predicted demand agrees with the actual demands realized. If investments occur after the first year, the average costs are calculated using the investments and demands within the study period, and are consistent with full recovery of all investments.

Since there are several pieces of SS7 equipment that are required to provide a service, the unit costs of the various equipment types need to be combined in different ways. The CCSCIS Aggregation Model calculates the combined cost from the costs of each piece of equipment and information about the architecture and engineering of the SS7 network. It uses costs of STPs and A links to calculate the costs of messages for setting up calls and some intelligent network services. For other intelligent network services, the combined costs include costs of SCPs, STPs, A links, and possibly D or B links. These costs can be combined with facility and/or switching costs to determine the total costs of calls or services.

CCSCIS Output Reports

Each CCSCIS model displays its calculations on output screens and produces requested reports of the outputs. For the SCP, STP, and Link models, the outputs include:

- Unit investments
- Total investments in each equipment category
- Utilization factors

Some of the models also display investments in each year of the study, and utilization of equipment in several years.

The STP models provide the unit investments for usage-sensitive costing as well as the investment per SS7 link termination. The latter is useful for determining the cost of connections to other carriers.

The Aggregation Model displays the combined costs and cost components as well as the combined unit investments for (1) circuit based services (call setup and some intelligent network services), (2) data base services (intelligent network services using SCPs), and (3) access and trunk signaling services.

CCSCIS Applications

The Common Channel Signaling Cost Information System (CCSCIS) is designed primarily to provide cost support for services that use a common channel signaling network using the SS7 protocol. The services may be basic services like trunk signaling for calls within the network or for access calls to another network. They may also be intelligent network services like CLASS, 800 Data Base Service, Alternate Billing Services, or the new Advanced Intelligent Network (AIN) services.

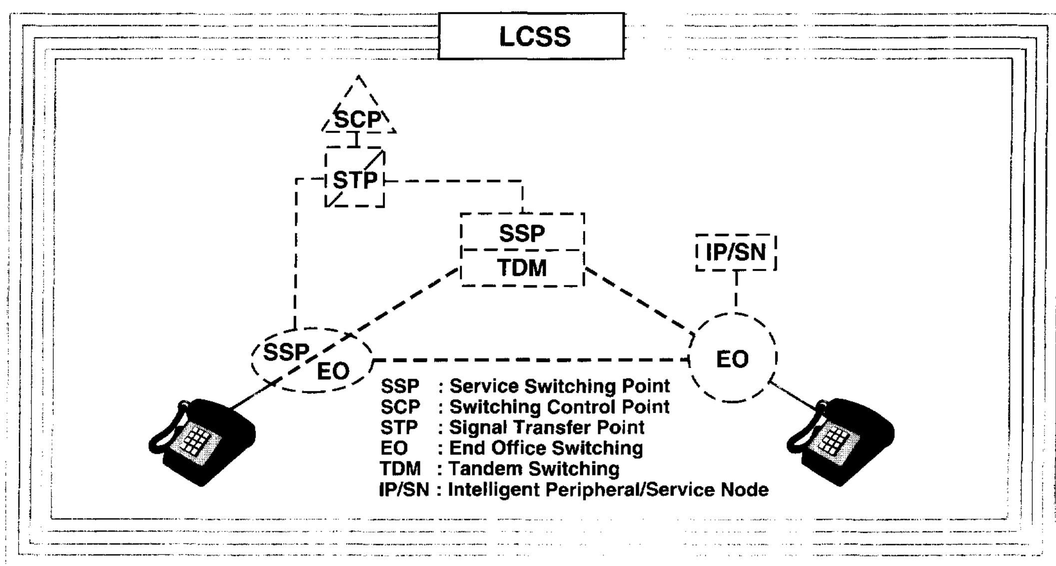
Since the individual cost "building blocks" are calculated within CCSCIS, they can be combined in different ways to produce costs specific to a serving area or customer. For example, if a data base service is provided to another company, the costs of the SCP, STP, and SS7 link equipment required for querying the SCP can be calculated. The interconnection costs of providing SS7 trunk signaling to another company can also be calculated.

Loop Cost Support Services (LCSS)

General Description

The following figure depicts the Loop Cost Support Services project which develops models, procedures, and methods for loop (circuit access) plant cost studies. Currently, two models are in production for this purpose. The Loop Characteristic and Investment System (LCIS) models outside plant characteristics and unit investment for a loop study area. The data for the LCIS model resides in a network data base with wire center specific content. Loop Cost Analysis Tool (LCAT) develops replacement costs for marginal and incremental average investments. The costs of the loop plant can be modeled in LCIS or from sample surveys and engineered circuit layouts. LCAT analyzes loop plant for a study area, accepts multiple technologies (fiber, digital loop carrier, and copper cable), topologies (star, ring, or bus), and service specific circuit access (narrowband, wideband, or broadband). The project team will furnish procedures for other aspects of loop plant cost studies on a unique, consultative basis.

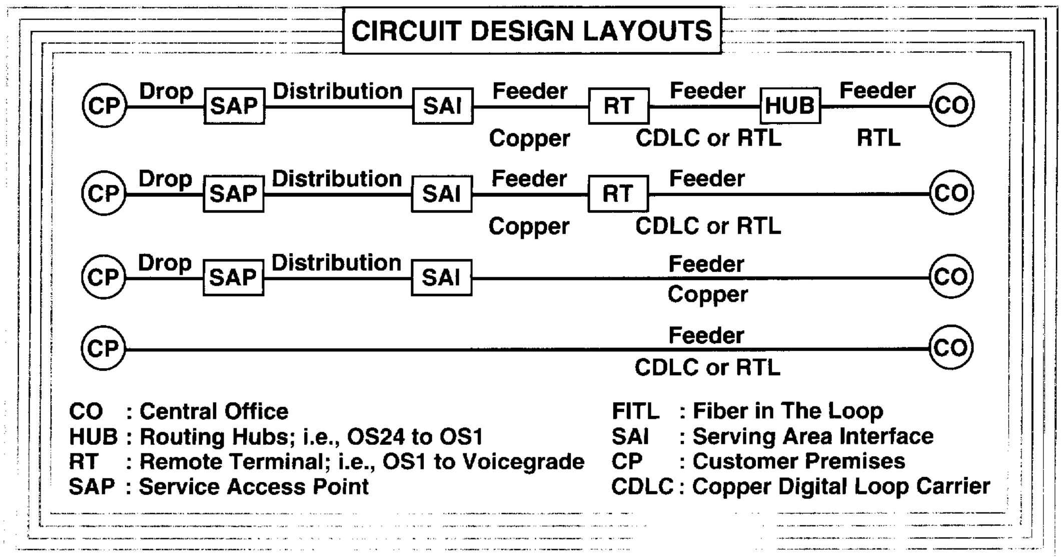
LCSS procedures classify loop plant by segment, that is, the feeder (primary, extensions, and sub-primary), the distribution, and the service access (drop, building entrance, and network interface). It provides methodology for the computation of the characteristics and cost for each function. LCSS procedures accommodate new and special services or special construction using its ability to configure circuit layouts to match the required loop plant technology, topology, and service delivery. LCSS loop plant cost studies can be used for regulatory support, revenue requirements, unbundling, and business decision support studies.



LCSS - Loop Cost Analysis Tool (LCAT)

General Description

LCAT, based upon user entered study parameters, calculates the replacement cost for the cost causative loop elements and compiles results by each applicable circuit design as displayed in the following figure. LCAT computes component costs based upon accepted capacity cost principles and technology placement standards. The results are an aggregate average of technology penetration and the various circuit designs employed by cost component and loop plant segment.



LCAT contains five modules: an optional **Equipment Investment** utility, the **Resource Tables** module, the **Study Parameters** module, the **LCAT Calculator** module, and the **Output Report** module.

The optional **Equipment Investment** computes the circuit component resource costs for the different circuit design layouts.

The **Resource Tables** allow the user to specify the study's assumptions.

The **Study Parameters** allow the user to specify the service delivery and the level of results.

The **LCAT Calculator** module contains the investment and cost calculation algorithms, performs the calculations, and feeds the output report database.

The **Output Report** module compiles the intermediate results produced by the LCAT Calculator module. It allows the user to view and print the study results in multiple ways.

LCAT Input Requirements

LCAT requires inputs for the Equipment Investment module, the Resource Tables module, and the Study Parameters module.

- The optional Equipment Investment utility requires data on loop-vendor equipment characteristics and price information by technology for each circuit design's span interface.

- The Resource Tables module requires data on the plant resource costs and mixes, topology, linking patterns (star, ring, or bus), engineering rules and standards, and economic accounting parameters such as investment loadings, annual cost factors, and price trend indices, and marginal cost assignments.

- The Study Parameters module requires data on the service and loop plant under analysis. The information includes service classification, jurisdiction, and study-specific details; such as type of study (network or individual circuit, flat rate or distance sensitive), service level (voice grade, wideband, or broadband), and service costing methodology (marginal, incremental, average investment or annualized costs).

LCAT System Processing

LCAT calculates service-specific marginal, incremental, and average replacement cost investments and will translate investment into annualized costs for the loop plant for revenue recovery requirements.

The optional LCAT Equipment Investment utility processes the equipment cost information for digital loop carrier and fiber multiplexed circuits. The module develops loop plant equipment unit resource costs for the LCAT Calculator.

The LCAT Resource Tables and Study Parameters provide loop plant mapping data, and economic and accounting information to the LCAT Calculator. The data allows the calculator to assign the loop plant equipment to account codes. Using utilization factors and price trend factors, the spare capacity may be loaded and the values are adjusted to the study year. Additional investments and other unspecified costs are calculated based on quantitative relationships, accounting rules, and corporate accounting reports. The annual cost factors allow the LCAT Calculator to determine the annualized costs.

The LCAT Calculator module uses technology and loop plant segment-specific cost algorithms to develop unit component investments for each loop technology for the service under study. The calculator determines the component costs of the loop plant cable and equipment, applies the adjusting, loading, and utilization factors to the loop plant components, and develops investments and annualized costs for the user-identified accounts. The calculator aggregates the data to develop investments and costs by circuit design and weights the various circuit designs to implement the user-specified specific loop plant configuration.

LCAT Output Reports

LCAT provides viewing and printing capabilities of the final and intermediate study results. The printed data can be employed by the user for cost study support. The format and content of the LCAT output reports can be specified by the user.

LCAT provides:

Study Results Summary and Detail Reports - Study results displayed by circuit design, technology, and distance band.

LCAT Calculator Module Worksheets - The identification and calculations of the investment and costs of the feeder, distribution, and drop segments.

LCAT Applications

LCAT is a service cost model which develops marginal, incremental, and average investments and costs of the loop plant. LCAT can be used in loop plant cost studies for regulatory initiatives such as Universal Service and cost deaveraging, as well as cost support for pricing, tariffing, and business decision support studies.

LCAT can determine the loop plant costs on an individual circuit basis for requests for proposals, and for special construction and individual contract studies. LCAT can perform distance sensitive studies for increments as small as one quarter of a mile or kilometer.

LCAT can assist in costing new and special services using its ability to configure circuit layouts to match the required loop plant technology, topology, and grade of service delivery.

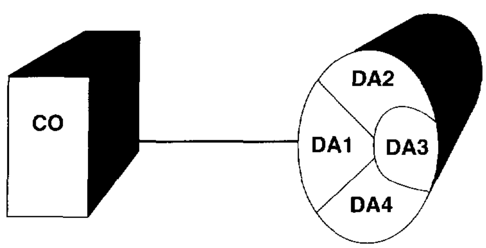
LCSS - Loop Characteristic and Investment System (LCIS)

General Description

Bellcore's Loop Characteristic and Investment System (LCIS) is a Windows™ database application program. It is primarily a preprocessor for Bellcore's Loop Cost Analysis Tool (LCAT), and it can be used as an alternative methodology to traditional loop sampling.

LCIS identifies loop characteristics and investments based on engineering records. These records include data that can be gathered manually from engineering plats and/or electronically from a corporate database. LCIS results are electronically linked to LCAT to develop geographic specific loop costs. LCIS allows the designation of one or more services, specific to the geographic area under study.

LCIS studies each distribution area to some degree of detail. The distribution area of the loop plant is defined as that part of the network that lies between the serving area interface and the service access point. The serving area interface is the crossconnect point into which enters a certain number of copper feeder cable pairs and a multiple of that number of pairs exits. The service access point terminates the drop segment that connects to the network interface, for example, the cross box atop a curbside telephone pole. Digital loop carrier or video serving areas may be considered to be distribution areas. Adjacent distribution areas may be aggregated into ultimate allocation areas (UAAs), as defined in Bellcore's Loop Engineering Information System (LEIS™).



CO	Central Office
UAA	Ultimate Allocation Area
DA	Distribution Area

When compared to traditional loop sampling methods, this approach has several distinct advantages:

- Statistical analyses are not required to determine sample size, sampling interval, confidence interval, and variance.
- Detailed segment parameters of embedded loops are not necessary and therefore less data gathering time per record is required.
- Loop characteristics are not dated. That is, the distribution areas or UAAs do not change size or move from their original locations.
- Service specific studies do not require separate sets of loop characteristics for previously identified distribution areas or UAAs.

LCIS Input Requirements

Since LCIS studies each distribution area or UAA, a complete census of the central office serving area is obtained. The required inputs are loop characteristics, such as length, size, and structure, and number of working lines, either total or by service.

LCIS System Processing

Average loop characteristics and investments are developed by weighting those of each distribution area or UAA by its number of working lines. The number of working lines can be total, service specific, or demand forecast.

Groups of distribution areas or UAAs can be identified and studied separately. Typical groups include central office areas, target market areas for competitive services, and jurisdictions.

Engineering rules, loop characteristics, and investments vary with distance from the central office. Often loop electronics are incorporated for great distances and copper twisted pair cable is placed close to the central office. For this reason, two distinct output ranges are identified through the LCIS user interface and each range is studied and reported separately. LCAT uses these two sets of data to produce a series of output reports for each. LCAT also weights them together according to their frequencies of occurrence in the network under study.

LCIS Output and Reports

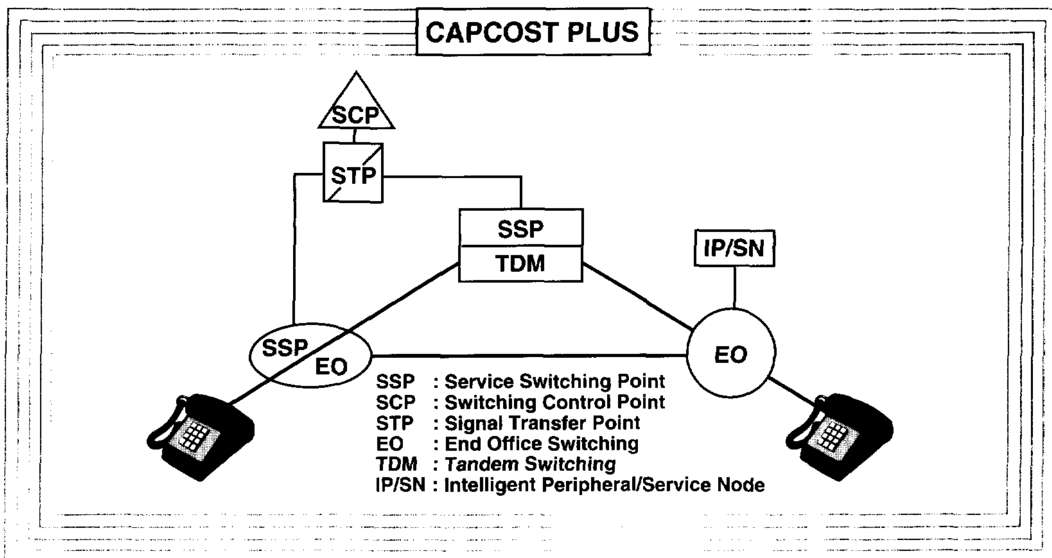
LCIS reports contain investment primitives and structural design of the average loop in the areas of interest. LCIS produces output in three formats:

- Report files identify the parameters that are used for input into LCAT. These files are formatted for printing and are easily included in the study documentation.
- Upload files each containing the data necessary for two consecutive, automatic runs of LCAT. One upload file is associated with each loop cost study.
- Summary files provide additional information not available in the report and upload files and are formatted for import into any spreadsheet application software for further processing.

The Capital Cost Analysis System (CAPCOST PLUS)

General Description

The following figure depicts the CAPCOST PLUS PC model which is used to calculate capital costs and operating expenses attributable to specific projects. The capital costs include such items as: depreciation, post tax income, and income tax expense. The operating expenses can include: maintenance, right-to-use fees, administrative, ad valorem taxes, gross receipts taxes, and user defined expenses. The model develops capital costs recognizing plant survivor characteristics, accelerated tax depreciation procedures, tax expenses and return on investment.



CAPCOST PLUS Input Requirements

The model has approximately 80 input variables for defining investment characteristics, operating expenses, and financial output options. They can be used in many combinations, as defined by each user. These input variables are divided into the following categories:

- Control Variables for Reference Years and Timing
- Conventions
- Global Financial Parameters
- Output Options
- Investment Tax Basis Factors
- Plant Survivor Characteristics
- Plant Investment Characteristics
- Book Depreciation, Salvage, and Cost of Removal Characteristics
- Tax Depreciation Characteristics
- Investment Tax Credit (when needed)
- Inflation Factors
- Investment Loadings
- Operating Expenses